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Xerothermic and anthropophytic species populations in the grassland communities of 'Skarpy Ślesińskie' Nature Reserve and its surroundings

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Abstract: Nature Reserve 'Skarpy Ślesińskie' and adjacent areas are the most important refuge of the thermophilous flora on the boundary of the Wielkopolska and Pomerania regions. The flora and vegetation of xerothermic grasslands, meadows and pastures and groves among them were investigated in that region. The field data were collected on the south-facing slopes of the Noteć river valley between Trzeciewnica and Ślesin. *Arabis hirsuta*, *Aster amellus*, *Astragalus cicer*, *Medicago minima*, *Seseli libanotis*, *S. annuum* and *Trifolium rubens* reported in the previous floras of the region have not been confirmed in the field. *Asperula tinctoria*, *Gentiana cruciata*, *Vicia tenuifolia* and *Viscaria vulgaris* were found for the first time. Grassland communities included the greatest number of the alien species (43). It can be explained by the relatively low plant coverage, the neighbourhood of the field and a small distance to the railway.

Key words: vascular flora, vegetation, grassland, xerothermic species, anthropophytes, 'Skarpy Ślesińskie' Nature Reserve, Wielkopolska, Pomerania

1. Introduction

About 38% of the vascular plant in the Wielkopolska is endangered (Żukowski & Jackowiak 1995). The thermophilous species are the most endangered ones. They are growing in the xerothermic grasslands, developed almost exclusively on the small, restricted areas under specific environmental conditions, formed or at least strongly changed due to human activity. The 'Skarpy Ślesińskie' Nature Reserve and adjoining areas of the escarpment of Noteć river valley are the typical example of that. The South-facing, abrupt (30°) slopes, formed by the river but ultimately modified as an effect of an undercut during construction of railway at the end of XIX century, are refuge of thermofilous flora, one of the most abundant in the northern Poland. The most abrupt, southern slopes near Ślesin are covered with the patches of flowery steppe, enormously vivid in spring. The gentle slopes are utilized as meadows and pastures. The groves and thicket communities, mostly of secondary origin, are developed on the East- and West-facing slopes.

The aim of the present study was to determine the changes in frequency of occurrence of relict steppe and some anthropogenic species in the grassland, meadow/pasture and woodland communities.

2. Material and methods

The study was based on phytocoenotic and floristic observations made in 2004 and 2005. The 25 of plant complexes were investigated. The complexes of vegetation landscapes were determined on the basis of utilization as xerothermic communities, grasslands and naturally developed groves (see Waldon *et al*. 2006) and documented with 16 phytosociological relevés. The 17 relevés made by Ceynowa-Giełdon (1991) were used as a comparative material to determine the changes in the frequencies of particular species. The floristic data of Bock (1908), Ceynowa (1961), Sulma & Walas (1963), Ceynowa-Giełdon (1991a, b) and Komendarczyk (1993) were also used. The coverage degree of particular species was estimated on the basis of historical and our relevés. Tables 1-3 based on own results.

Table 1. Participation of thermophilous plant species in the vegetation complexes of 'Skarpy Ślesińskie' Nature Reserve and its surroundings

Species names	xerothermic grasslands		meadow/ pasture		woodland communities	
	F	SC	F	SC	F	SC
Scabiosa ochroleuca	1	r	-	-	-	-
Silene otites	1	r	-	-	-	-
Thymus pulegioides	1	+	-	-	-	-
Acinos arvensis	1	+	-	-	-	-
Anthemis tinctoria	1	+	-	-	-	-
Cerastium semidecandrum	1	+	-	-	-	-
Corynephorus canescens	1	+	-	-	-	-
Lathyrus sylvestris	1	+	-	-	-	-
Polygala comosa	1	+	-	-	-	-
Ranunculus bulbosus	1	+	-	-	-	-
Scorzonera purpurea	**1**	**+**	**-**	**-**	**-**	**-**
Myosotis stricta	1	2m	-	-	-	-
Asperula tinctoria	**2**	**+ : 1**	**-**	**-**	**-**	**-**
Carex caryophyllea	2	r : +	-	-	-	-
Potentilla argentea	3	+	-	-	-	-
Stipa joannis	**3**	**+ : 3**	**-**	**-**	**-**	**-**
Poa compressa	4	+ : 2m	-	-	-	-
Alyssum alyssoides	4	1 : 2m	-	-	-	-
Anthericum ramosum	5	+ : 2b	-	-	-	-
Avenula pratensis	**6**	**r : 2m**	**-**	**-**	**-**	**-**
Sedum acre	6	+ : 2m	-	-	-	-
Artemisia campestris	6	+ : 2m	-	-	-	-
Phleum phleoides	7	1 : 2a	-	-	-	-
Veronica spicata	9	+ : 2b	-	-	-	-
Carlina vulgaris	1	r	1	+	-	-
Verbascum lychnitis	2	+	2	1	-	-
Gentiana cruciata	**2**	**+**	**2**	**+**	**-**	**-**
Peucedanum oreoselinum	3	+ : 2m	1	r	-	-
Astragalus glycyphyllos	3	+ : 1	2	r : +	-	-
Hieracium pilosella	3	+	3	r : +	-	-
Centaurea scabiosa	4	+	3	+ : 1	-	-
Carex praecox	4	+ : 2a	1	+	-	-
Cerastium arvense	5	+	1	+	-	-
Coronilla varia	5	+ : 1	1	+	-	-
Arenaria serpyllifolia	5	r : 1	1	+	-	-
Anemone sylvestris	**5**	**+ : 2b**	**1**	**1**	**-**	**-**
Centaurea stoebe	6	+ : 2b	2	+ : 1	-	-
Helianthemum nummularium	6	+ : 2b	1	r	-	-
Poa angustifolia	6	+ : 1	1	+	-	-
Thalictrum minus	8	+ : 2m	3	r : +	-	-
Adonis vernalis	**8**	**+ : 2a**	**2**	**r : +**	**-**	**-**
Dianthus carthusianorum	9	+ : 2b	2	+	-	-
Achillea pannonica	9	+ : 2m	5	r : 2a	-	-
Campanula sybirica	**9**	**+ : 2m**	**5**	**r : 2m**	**-**	**-**
Erigeron acris	2	r : +	7	+ : 2m	-	-
Medicago falcata	10	+ : 2b	3	+ : 1	2	+
Galium verum	10	+ : 2b	4	+ : 1	3	r : +
Euphorbia cyparissias	10	+ : 2a	5	+ : 1	4	r : +
Festuca trachyphylla	8	+ : 2m	1	1	1	+
Filipendula vulgaris	8	+ : 3	2	+ : 1	1	r
Potentilla arenaria	8	+ : 2b	1	+	1	r
Stachys recta	**8**	**+ : 2b**	**1**	**+**	**1**	**r**
Salvia pratensis	8	+ : 2b	3	+	1	+
Brachypodium pinnatum	8	+ : 2b	5	+ : 1	6	+ : 1
Bromus inermis	8	1 : 2m	5	r : 1	1	+
Fragaria viridis	8	1 : 2b	3	+ : 2m	3	+
Asparagus officinalis	8	r : 2m	2	+	4	r : +
Agrimonia eupatoria	7	+ : 2b	6	r : 1	1	+
Vicia tenuifolia	**6**	**+ : 2b**	**7**	**r : +**	**4**	**+**
Pimpinella saxifraga	5	+ : 2m	4	+ : 2m	1	+
Hypericum perforatum	4	+	6	+ : 1	5	+
Alium oleraceum	2	+	1	r	1	+
Trifolium medium	3	+ : 1	-	-	1	+
Sedum maximum	4	r : +	-	-	1	+
Campanula rapunculoides	1	+	-	-	3	r : 2a
Hieracium umbellatum	-	-	2	+ : 1	1	+
Polygonatum odoratum	-	-	-	-	1	+
Rumex acetosella	-	-	-	-	2	+

Explanations: F – number of occurrences; SC – range of the species cover in Braun-Blauquet scale (Barkman *et al*. 1964, modification); the most interesting xerothermic plant species marked with bold font

Table 2. Participation of anthropophytes in the vegetation complexes of 'Skarpy Ślesińskie' Nature Reserve and its surroundings

	geographical-historical group	sociological group	xerothermic grasslands		meadows/ pastures		woodland communities	
			F	SC	F	SC	F	SC
Populus ×canadensis	Kn	-	1	r	-	-	-	-
Galanthus nivalis	Kn	-	1	r	-	-	-	-
Vicia hirsuta	Ar	Sm	1	+	-	-	-	-
Diplotaxis tenuifolia	Kn	SmSis	1	+	-	-	-	-
Onopordon acanthium	Ar	A	1	+	-	-	-	-
Artemisia absinthium	Ar	A	1	1	-	-	-	-
Solidago gigantea	Kn	ACs	1	1	-	-	-	-
Sisymbrium altissimum	Kn	SmSis	1	3	-	-	-	-
Papaver argemone	Ar	Sm	2	+	-	-	-	-
Bromus tectorum	Ar	SmSis	2	+ : 1	-	-	-	-
Centaurea cyanus	Ar	Sm	2	r : +	-	-	-	-
Capsella bursa-pastoris	Ar	Sm	3	r : +	-	-	-	-
Hemerocallis fulva	Df	-	1	r	1	r	-	-
Viola arvensis	Ar	Sm	1	+	1	r	-	-
Lathyrus tuberosus	Ar	-	1	+	1	+	-	-
Conyza canadensis	Kn	SmSis	1	+	2	+	-	-
Veronica arvensis	Ar	Sm	2	+	1	+	-	-
Rumex thyrsiflorus	Kn	M-A	2	+	1	r	-	-
Vicia angustifolia	Ar	Sm	2	+	3	r : +	-	-
Descurainia sophia	Ar	SmSis	3	+ : 2	1	r	-	-
Sisymbrium loeselii	Kn	SmSis	1	1	1	r	1	+
Syringa vulgaris	Kn	-	1	1	1	r	1	+
Vicia tetrasperma	Ar	Sm	1	1	2	+ : 1	1	+
Prunus domestica	Df	-	1	r	1	+	1	2b
Medicago sativa	Kn	-	1	+	4	r : +	1	r
Lycium barbarum	Kn	A	2	+ : 3	1	1	1	+
Malus domestica	Kn	-	2	r : +	1	+	2	r
Myosotis arvensis	Ar	Sm	2	r	3	r : +	1	+
Ballota nigra	Ar	A	2	+	1	r	6	+ : 2m
Carduus acanthoides	Ar	A	3	+ : 1	2	+ : 1	1	+
Consolida regalis	Ar	Sm	3	1 : 2m	2	r : +	1	+
Papaver dubium	Ar	Sm	3	+ : 2m	1	+	1	+
Papaver rhoeas	Ar	Sm	4	r : 2m	3	r : +	1	r
Lactuca serriola	Ar	SmSis	4	+	2	r : +	3	+ : 1
Convolvulus arvensis	Ar	A	7	+ : 2m	7	+ : 2m	5	+
Senecio vernalis	Kn	Sm	7	r : 2b	1	+	1	r
Lithospermum arvense	Ar	Sm	4	+ : 2m	-	-	1	+
Morus alba	Df	-	1	1	-	-	1	r
Fallopia convolvulus	Ar	Sm	1	1	-	-	2	+
Ligustrum vulgare	Kn	R-P	1	r	-	-	3	r : +
Bromus sterilis	Ar	SmSis	1	+	-	-	3	+
Bryonia alba	Kn	-	1	r	-	-	3	r : +
Fumaria officinalis	Ar	Sm	-	-	1	r	-	-
Geranium pusillum	Ar	Sm	-	-	1	r	-	-
Anchusa arvensis	Ar	Sm	-	-	1	r	-	-
Raphanus raphanistrum	Ar	Sm	-	-	1	r	-	-
Cichorium intybus	Ar	-	-	-	1	+	-	-
Vicia villosa	Ar	Sm	-	-	2	+	-	-
Padus serotina	Kn	-	-	-	1	r	2	r
Lamium purpureum	Ar	Sm	-	-	1	+	2	r : +
Thlaspi arvense	Kn	Sm	-	-	2	r : +	2	+
Lamium album	Ar	A	-	-	2	+	4	+
Solanum nigrum	Ar	Sm	-	-	-	-	1	r
Atriplex patula	Ar	SmSis	-	-	-	-	1	r
Ribes aureum	Kn	-	-	-	-	-	1	r
Secale cereale	Df	-	-	-	-	-	1	r
Cerasus vulgaris	Df	-	-	-	-	-	1	+
Atriplex nitens	Ar	SmSis	-	-	-	-	1	+
Picea abies	Kn	V-P	-	-	-	-	2	r : +
Larix decidua	Kn	-	-	-	-	-	2	r : +
Robinia pseudoacacia	Kn	A	-	-	-	-	3	r : +
Cerasus avium	Df	-	-	-	-	-	3	r : 1
Chenopodium hybridum	Ar	-	-	-	-	-	3	r
Ribes uva-crispa	Kn	-	-	-	-	-	6	r : +

Explanations: Ar – archaeophytes; Kn – kenophytes; Df – diaphytes; M-A – *Molinio-Arrhenatheretea*; A – *Artemisietea vulgaris*; ACs – *Artemisietea vulgaris* (*Convolvuletalia sepium*); SmSis – *Stellarietea mediae* (*Sisymbrietalia*); Sm – *Stellarietea mediae* (*Aperetalia spicae-venti, Papaveretalia rhoeadis*); R-P – *Rhamno-Prunetea*; V-P – *Vaccinio-Piceetea*; F – number of occurrences; SC – range of the species cover in Braun-Blauquet scale (Barkman *et al*. 1964, modification)

Names of plant follow Mirek *et al.* (2002), phytoecenotic character of the species Matuszkiewicz (2001), and geografic-historical was taken after Jackowiak (1990). The names of plant communities follow Brzeg & Wojterska (2001).

3. Results

Arabis hirsuta, *Aster amellus*, *Astragalus cicer*, *Medicago minima*, *Seseli libanotis*, *S. annuum* and *Trifolium rubens*, reported previously by Preuss (1912), Sulma & Walas (1963), Ceynowa (1961), Ceynowa-Giełdon (1991) have not been found. *Asperula tinctoria*, *Gentiana cruciata*, *Vicia tenuifolia* and *Viscaria vulgaris* were noted for the first time.

The most of helio- and thermofilous plant species were found in the xerothermic grasslands, 33 species in the associations from the *Festuco-Brometea* class, 20 from the *Trifolio-Geranietea* and 14 from the *Koelerio-Corynephoretea* classes (Tables 1 and 3). The occurrence of taxa characteristic for those vegetation classes is strongly reduced on the meadow/pasture lands and in the woodland islands among them. The regression of psammophilous species representing the *Koelerio-Corynephoretea* class is the most notable. Only 5 of them occurred in the meadow-pasture complex and only 2 in the groves. The participation of character species of the *Festuco-Brometea* class also decreased drastically – to 18 among the meadow-pasture complex and to 9 in the woodland islands. The character species of the *Trifolio-Geranietea* class have broader ecological amplitudes and 15 of them were recorded among meadow/pasture but 13 in the grove communities.

The 43 species of alien plants have been found in the xerothermic grassland communities, 34 in the complex of meadow/pasture land and 38 in the woodlands (Tables 2 and 3). Comparing these numbers with the floristic diversity of the three plant complexes distinguished, the greatest percentage of alien plant species is characteristic for the meadow/pasture and woodland complexes (20.4 and 19.9%, respectively), while in the grasslands it has the lowest level (18.4%). The anthropophytes were strongly represented, but as a rule they showed the low stability. The archaeophytes are the most frequent and are found in the all three vegetation complexes distinguished (Tables 2 and 3).

4. Discussion

The comparison of the present numbers of populations of species with the historical data shows not only the changes, but also their dynamic tendencies. The increase of number of individuals was found in the populations of *Anemone sylvestris*, *Asparagus officinalis*, *Carlina vulgaris*, *Peucedanum oreoselinum* and *Stipa joannis*. The decrease of number of individuals showed populations of *Acinos arvensis*, *Polygala comosa*, *Scabiosa ochroleuca*, *Silene otites* and *Thymus pulegioides*. In contrary, the size of the *Adonis vernalis* population has not changed.

Jackowiak (2003) recorded occurrence of 58 character taxa for the xerothermic grasslands of the *Festuco-Brometea* class in the Wielkopolska region. The 32 species representing this class found in the 'Skarpy Ślesińskie' Nature Reserve constitute more than 55% of them. The 21 out of the total 58 species characteristic for the xerothermic grasslands reported by Jackowiak (2003), occurred mostly on the anthropogenic sites, more or less changed during human activity. Some of them are expansive, as for example *Artemisia campestris*, *Bromus inermis*, *Euphorbia cyparissias* and *Carex praecox* (Sulma & Walas 1963; Jackowiak 2003). The latter are also very widespread on the slopes of the Noteć river valley between Ślesin and Trzeciewnica. The more numerous taxa characteristic for the xerothermic grasslands have a hemerophobic character and are in more or less deep regression in the Wielkopolska and

Table 3. Participation of some phytocoenotical groups and anthropophytes in the vegetation complexes of Skarpy Ślesińskie Nature Reserve and its surroundings

	xerothermic grasslands	meadows/ pastures	woodland communities
Number of vegetation complexes	10	7	8
Total number of species	233	167	191
Number of species from class:			
Festuco-Brometea	33	18	9
Trifolio-Geranietea	20	15	13
Koelerio-Corynephoretea	14	5	2
Stellarietea mediae	23	20	15
Artemisietea	7	4	6
Number of anthropophytes	43	34	38
archaeophytes	24	22	18
kenophytes	15	10	15
diaphytes	4	2	5

Pomerania regions (Czubiński 1952; Sulma & Walas 1963; Ceynowa 1968; Ceynowa-Giełdon & Waldon 2001; Chmiel 1993; Żukowski & Jackowiak 1995; Żukowski *et al*. 2001; Jackowiak 2003).

The frequencies of occurrence of anthropogenic species in the Skarpy Ślesińskie Nature Reserve and its surroundings are generally more difficult to be compared because of restricted data from the historical times. The species concurrent with man have only occasionally been reported by earlier authors. For example such common species as *Senecio vernalis* and *Sisymbrium altissimum* are reported from the 'Skarpy Ślesińskie' for the first time in the present study. The great number of species found in the grassland communities on the strongly inclined slopes can result from the low cover degree of vegetation and also the close spatial contact with the field and with railway. The great influence of the field weed taxa is expressed with their phytocoenotic character, because most of them are characteristic for the *Stellarietea mediae* class, among them 23 species are found in the grasslands, 20 in the meadow/pastures and 15 in the grove communities. The second group of the alien species is characteristic for the *Artemisietea* class – the 7 species occur in the grasslands, 4 in the meadows/pastures and 6 in the groves.

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